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Color Pattern Inheritance in Some Frogs of the Genus *Eleutherodactylus*

Coleman J. Goin
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The frog genus *Eleutherodactylus,* which comprises approximately **225** nominal forms, is distributed throughout tropical America. Some of the species are wide ranging, but many occupy very restricted areas, in some cases being limited to narrow altitudinal zones on particular islands in the Antilles, a region in which more than **70** of the known forms occur. The genus is, from the point of view of systematics, one of the more complex groups of New World frogs, not only because of the problems of distribution and evo- lution which it poses, but also because of the great variability in color pattern shown by many of the species.. While some have only one pattern and others are known that have just two, still other species have as many as eight or more different color patterns.

In a recent paper (Goin, **1947)** I presented evidence that the pattern of dorsolateral stripes in *Eleutherodactylus ricordii planirostris* is inherited as a simple Mendelian dominant over the mottled pattern and suggested the desirability of further work on the inheritance of pattern differences in species having three or more patterns. With the aid of a grant from the Permanent Science Fund of the American Academy of Arts and Sciences, I was able during the summer of **1948** to obtain data on the inheritance of color patterns in *E. nubicola* **Dunn,** *alticola* Lynn, and *pantoni* **Dunn,** species having more than three patterns.

I wish to extend my thanks to the officers of the American Academy of Arts and Sciences for the grant which made this study possible. C. Bernard Lewis, Curator of the Science Museum, The Institute of Jamaica, was extremely helpful in introducing me to the island and in arranging for my

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stay there; to him I extend my thanks. I wish to thank E. W. March and E. M. Brown, of the Forest Department of Jamaica, for making the Forest Hut at Clydesdale and the services of a guide available. Bonner E. C. Shekell, of Chester Vale, St. Andrew, Jamaica, very generously cared for the eggs which were unhatched at the time of my departure from the island and preserved and forwarded the hatchlings to me after my return to Gainesville. I am greatly indebted to him for this kindness. I have gained much from a discussion of these data with my colleagues, Arnold B. Grobman, James A. Oliver, and J. C. Dickinson, and with my wife, Olive Bown Goin. Finally I wish to thank Dennis E. Miller, Byrum W. Cooper, and Robert H. Barth, Jr., for assistance in collecting and for companionship in the field.

Eleutherodactylus nubicola Dunn

Eleutherodactylus nubicola is a montane species occurring in the Blue Mountains of Jamaica between the altitudes of 4 000 and 6000 feet. Its life history and embryology have been described in detail by Lynn (1942). The females lay from 26 to 75 eggs under rocks along the mountain trails. Fertilization is external, the eggs being fertilized by a single male at the time the clutch is deposited. The female remains with the eggs during intra-ovular development, and it is thus possible in many cases to determine the phenotype of the female parent of clutches of eggs collected in the field. That this is not always possible is due largely to the exigencies of collecting since at times the female escapes before her pattern can be noted.

The eight known pattern variations in *E. nubicola* seem to result from various combinations of three modifications of a basic pattern. This basic pattern I shall call *Mottled,* and its three modifications I shall designate *Dorsolateral Stripes, Picket,* and *Middorsal Stripe.* They are illustrated in Plate I and may be described as follows:

Mottled. The Mottled pattern consists of a brown background overlaid by a mottling of dark brown **or black. The** most consistent element of this pattern is the arrangement of dark pigment in a W-shaped mark on the back in the suprascapular region. This W-shaped mark extends from above the arm on one side of the back to above the arm on the opposite side with the apex of the middle portion being directed anteriorly and being located precisely on the midline of the back. Generally the area of the back immediately caudad of the two posteriorly directed apices of the W is somewhat lighter than the surrounding dorsum. Posterior to this lighter area, a fainter wavy line of dark pigment is discernible. In addition, a dark interocular bar is present. It is of interest to note that the W-shaped mark described above is the one so easily recognized in many different species of *Eleutherodactylus.*

Furthermore, the three basic *nubicola* pattern modifications described below are all associated in some manner or other with this W-mark. Most of the variation in the Mottled pattern is apparently due to intensity of pigmentation. While there is a great deal of individual variation, there appears to be a general tendency for intensity of pigmentation to increase with age. In hatchlings the pattern as described above is immediately apparent, but in large mature individuals it is quite often obscured by a general darkening of the dorsum. This pattern seems to be essentially the same as the one I have described as Mottled in *E. r. planirostris.*

Dorsolateral Stripes. This pattern consists of two broad cream-colored bands, one on each side, originating on the posterior margins of the upper eyelids, passing posteriorly above the tympani directly backward through the arms of the W and finally terminating on the back above the insertions of the hind limbs. As the cream-colored bands pass through and thus obliterate the arms of the W, all that is left of this mark is the central portion forming a A-shaped mark in the suprascapular region between the two lateral **stripes.**

Picket. In this pattern there is a light area bounded anteriorly by the posterior margin of the middle section of the W-mark. Behind the two posterior apices of the W the lateral margins of this light area appear comparable to the median margins of the cream-colored areas in individuals which have Dorsolateral Stripes. Thus when both Dorsolateral Stripes and Picket patterns occur in the same individual, the light picket occupies the entire area between the dorsolateral stripes posterior to the W-mark.

Middorsal Stripe. This pattern in the adults consists of a narrow cream-colored median line extending from the snout to the vent, there branching and continuing on the posterior margin of each leg to the sole of the foot, terminating at the juncture of the fourth and fifth toes. Ventrally, a median, narrow, cream-colored line extends from the tip of the chin to the crotch. It should be noted that this is the only one of the patterns herein described that carries over onto the ventral side of the body. The midventral portion of this pattern tends to become obliterated with increasing size (hence age) of the individual, but is discernible as a median line on the chin and throat in the largest specimens. In hatchlings the middorsal portion of this line extends only as far forward as the median anteriorly directed apex of the W but in mature individuals it continues on to the snout. This narrow median line should not be confused with a broad middorsal line which occurs in many species of *Eleutherodactylus,* including *nubicola.* I have seen it in two of **the** 1302 individuals of *nubicola* that I have examined for pattern. While there is no evidence to date that the broad middorsal stripe has any genetic

relationship with the narrow middorsal stripe described here, it is interesting to speculate that it may be due to an allelomorph.

Since it is possible to get any combination of patterns in a single individual, there can be eight different phenotypes in this species, as follows:

Mottled
Dorsolateral Stripes
Picket
Middorsal Stripe
Dorsolateral Stripes plus Picket
Dorsolateral Stripes plus Middorsal Stripe
Picket plus Middorsal Stripe
Dorsolateral Stripes plus Picket plus Middorsal Stripe

All of the above possible combinations have been observed in specimens of *nubicola.*

For a genetical analysis of color pattern inheritance in *nubicola,* the following data are available:

(1) The phenotypic ratio of the wild population. A total of 300 specimens was collected along the mountain trail in the same area in which the eggs were collected and comprise the following patterns or pattern combinations. The females with eggs are included.

Mottled - 222
Dorsolateral Stripes - 32
Picket - 21
Middorsal Stripe - 21
Dorsolateral Stripes plus Middorsal Stripe - 2
Picket plus Middorsat Stripe - 2

(2) Seven hundred sixty-seven hatchlings from nineteen clutches of eggs of which the pattern of the mother is known. These were as follows:

Mother - Mottled (13 clutches)
26 Mottled, 20 Dorsolateral Stripes
25 Mottled, 28 Middorsal Stripe
25 Mottled, 26 Middorsal Stripe
26 Mottled
43 Mottled
58 Mottled
47 Mottled
42 Mottled
53 Mottled
21 Mottled
51 Mottled
33 Mottled
41 Mottled

Mother - Dorsolateral Stripes (3 clutches)
31 Dorsolateral Stripes
9 Mottled, 8 Dorsolateral Stripes
5 Mottled
Mother - Picket (1 clutch)
7 Mottled, 4 Dorsolateral Stripes, 3 Picket, 4 Middorsal Stripe,
3 Dorsolateral Stripes plus Picket, 5 Picket plus Middorsal Stripe,
5 Dorsolateral Stripes plus Picket plus Middorsal Stripe
Mother - Middorsal Stripe (2 clutches)
29 Mottled, 16 Middorsal Stripe 34
Mottled, 39 Middorsal Stripe

(3) Two hundred thirty-five hatchlings from six clutches of eggs in which the phenotype of neither parent is known.

48 Mottled
60 Mottled
34 Mottled
39 Mottled
5 Mottled, 4 Dorsolateral Stripes
23 Mottled, 22 Middorsal Stripe

In the following genetic discussion the gene for Dorsolateral Stripes is indicated by ***S,*** the gene for Picket by ***P,*** and the gene for Middorsal Stripe by ***M.***

For a consideration of the question of whether the three characters are determined by genes which are multiple alleles or whether these genes occur in different loci, the evidence must be taken from the phenotypic composition of the individual clutches. Obviously, the most complex series of offspring from a single clutch is the set of thirty-one young with a Picket mother which exemplify seven of the eight possible combinations of patterns. The presence of seven of the pattern combinations in one set precludes the possibility that the three basic pattern modifications are due to multiple alleles. Let us assume that three different pairs of genes are involved and that the genes for Dorsolateral Stripes, Middorsal Stripe and Picket are dominant. (For the basis of these assumptions, see discussion below.) Since there are Mottled offspring in this clutch, it would not be possible for either parent to have been homozygous for either Dorsolateral Stripes, Picket, or Middorsal Stripe. As both Dorsolateral Stripes and Middorsal Stripe occur among the offspring in approximately a 1:1 ratio, although absent in the mother, both of these patterns should have been present in the father. Thus, on the basis of the assumptions given above, the mother was heterozygous for Picket **and** homozygous recessive for Dorsolateral Stripes and Middorsal Stripe and the father was heterozygous for Dorsolateral Stripes and Middorsal Stripe and homozygous recessive for Picket, and there should be, according to the laws of chance, an equal distribution of the eight possible phenotypes in the off-

spring. This cross, and the theoretical phenotypical composition of the clutch, is compared below with the actual phenotypes of the thirty-one offspring of the female with Picket pattern.

s s P p m m x S s p p M m

Offspring

	Theoretical	Actual
Mottled	3.875	7
Dorsolateral Stripes	3.875	4
Picket	3.875	3
Middorsal Stripe	3.875	4
Dorsolateral Stripes plus Picket	3.875	3
Dorsolateral Stripes plus Middorsal Stripe	3.875	0
Picket plus Middorsal Stripe	3.875	5
Dorsolateral Stripes plus Picket plus Middorsal Stripe	3.875	5

Moreover, if the parents were ss Pp mm X Ss pp Mm, there should be for each of the three traits (Dorsolateral Stripes, Middorsal Stripe, and Picket) when considered separately, an equal distribution among the offspring. Below the theoretical number is compared with the actual number of each of the three traits considered independently.

	Theoretical	Actual
Dorsolateral Stripes present	15.5	12
Dorsolateral Stripes absent	**15.5**	19
Picket present	15.5	16
Picket absent	15.5	15
Middorsal Stripe present	15.5	14
Middorsal Stripe absent	15.5	17

The actual ratios obtained for Middorsal Stripe and Picket patterns are obviously very close to the expected ratios and a ratio of 12 to 19 is no more divergent than would be expected in a random sample 40 per cent of the time. These data are thus consistent with the hypothesis that there are three pairs of genes.

Finally, if these patterns are due to independent genes, considering one pattern at a time, the offspring from all clutches containing individuals both with and without the pattern in question should be in a ratio either of 3:1 or 1:1, depending on whether one or both parents were heterozygous. The actual results may be summarized as follows.

Clutches containing both Mottled and Dorsolateral Stripe offspring:

9 Mottled, 8 Dorsolateral Stripes 19
Mottled, 12 Dorsolateral Stripes 26
Mottled, 20 Dorsolateral Stripes 5
Mottled, 4 Dorsolateral Stripes

Clutches containing both Mottled and Picket offspring: 15
Mottled, 16 Picket

Clutches containing both Mottled and Middorsal Stripe offspring:

17 Mottled, 14 Middorsal Stripe 25
Mottled, 28 Middorsal Stripe 25
Mottled, 26 Middorsal Stripe 29
Mottled, 16 Middorsal Stripe 34
Mottled, 39 Middorsal Stripe 23
Mottled, 22 Middorsal Stripe

Each of the above is surprisingly close to the theoretical 1:1 ratio with the exception of the clutch containing 29 Mottled and 16 with Middorsal Stripe.

While it is thus demonstrable that the three sets of genes cannot all be in a single series of multiple alleles, there remains the possibility that any two of them may be situated in the same locus. Further data are necessary to clarify this point.

In *Eleutherodactylus ricordii planirostris* evidence was available from enough clutches of eggs in which the color patterns of both parents were known to indicate rather conclusively that the gene for Dorsolateral Stripes is dominant (Goin, 1947). In no case in *E. nubicola* was a clutch of eggs obtained for which both parents were known. Indirect evidence may be sought by using the equilibrium formula to determine the genotypic ratio of the wild population and on this basis predicting the number of clutches which should contain only individuals with the pattern in question, clutches which should contain individuals both with and without the pattern, and clutches with no individuals having the pattern. Each of the patterns will be considered separately.

DORSOLATERAL STRIPES

The phenotypic ratio of the 300 individuals was 34 with Dorsolateral Stripes and 266 without. If Dorsolateral Stripes is considered dominant, then .88667 = $(1 - q)^2$ in the equilibrium formula

$$q^2 SS : \quad - q) Ss : (1 - q)^2 ss.$$

The figure .88667 can then be substituted in the formula and the probable

gene distribution of the natural population calculated.

(1 4 ^{2} = .88667	ss = 88.67 % without Dorsolateral Stripes
2q(1--q) = .10993	Ss = 10.99 % with Dorsolateral Stripes
cr^2 .00341	SS = 0.34% with Dorsolateral Stripes

Assuming random mating, a table can now be constructed to show the probable offspring.

TABLE I

	.00341 SS	.10993 Ss	.88667 ss
.00341 SS	.000012 SS	.000375 SS ± Ss	.003024 Ss
.10993 Ss	.000375 SS + Ss	.009063 SS ± Ss .003021 ss	.048736 Ss .048736 ss
.88667 ss	.003024 Ss	048736 . Ss S .048736 as	.786184 ss

It can then be calculated that, assuming the gene for Dorsolateral Stripes to be dominant, out of the 25 clutches collected, 19.65 should have been entirely without Dorsolateral Stripes, 5.18 should have been mixed, and 0.18 should have contained only individuals with Dorsolateral Stripes. If we go through the same steps assuming Dorsolateral Stripes to be recessive, it can be determined that theoretically of the 25 clutches collected, 17.16 should have been entirely without Dorsolateral Stripes, 7.52 should have been mixed, and 0.32 should have contained only individuals with Dorsolateral Stripes. These are compared with the actual results in Table II.

TABLE II

	Theoretical Clutches Dorsolateral Stripes dominant	Theoretical Clutches Dorsolateral Stripes recessive	Actual Clutches
Without Dorsolateral Stripes only	19.65	17.16	20
Mixed	5.18	7.52	4
Dorsolateral Stripes only	0.18	0.32	1
	X^2 = 0.229	x2 = 1.498	
	P = 85%	P = 22%	

On the basis of these calculations, it can be seen from the x^2 and corresponding P values that the alternative assumptions that the gene for Dorsolateral Stripes is dominant to the absence of Dorsolateral Stripes or that it is recessive are both consistent with the data. There is here no evidence for choosing between the alternatives.

PICKET

On the basis of 23 out of the sample of 300 individuals of the wild population having the Picket pattern and 277 lacking this pattern, similar calculations may be made and compared with the actual results.

TABLE III

	Theoretical Clutches Picket dominant	Theoretical Clutches Picket recessive	Actual Clutches
Without Picket only	21.314	19.31	24
Mixed	3.601	5.54	1
Picket only	0.077	0.15	0
	x^2 =2.288	x^2 = 5.006	
	P = 14%	P = 2.8%	

In this case it would be consistent with the data to assume the gene determining the Picket pattern to be dominant.

MIDDORSAL STRIPE

On the basis of 25 out of the sample of 300 individuals of the wild population having the Middorsal Stripe and 275 lacking it, similar calculations may be made and compared with the actual results.

TABLE IV

	Theoretical Clutches Middorsal Stripe dominant	Theoretical Clutches Middorsal Stripe recessive	Actual Clutches
Without Middorsal Stripe only	21.01	18.90	19
Mixed	3.90	5.93	
Middorsal Stripe only	0.09	0.17	0
	x^2 = 1.200	x2 = 0.002	
	P = 28%	P = 94%	

In this case also it would be consistent with the data to assume the gene determining the Middorsal Stripe to be either dominant or recessive.

Eleutherodactylus alticola Lynn

This species is restricted to the higher slopes of the Blue Mountains of Jamaica. The life history is similar to that of *nubicola* except that the eggs are more adhesive and fewer in number (average clutch 23). The female acts as a guardian in this species as is the case in *nubicola.* In *alticola,* however, so many individuals and clutches of eggs may be found together in one breeding site such as the rock heap at Blue Mountain Peak, that it is at times impossible to be sure which female is with any particular set of eggs.

It should be mentioned here that although the patterns are described and illustrated as they occur in *nubicola* they are enough alike in the different species to be easily recognized. Picket and Middorsal Stripe seem to be practically identical in the species I have seen in which they occur. There are some differences in the Mottled and Dorsolateral Stripes patterns from species to species but in every case I know these patterns are distinctive enough to be readily recognized.

In *alticola,* only two of the primary modifications of the basic Mottled pattern are present, Middorsal Stripe and Dorsolateral Stripes, thus permitting four phenotypes. Of **131** adults collected during a single morning on Blue Mountain Peak, **86** were Mottled, **35** had Dorsolateral Stripes, **9** had Middorsal Stripe, and 1 had both Dorsolateral Stripes and Middorsal Stripe.

The following clutches of eggs were taken:

18 Mottled	**18 Mottled**
18 Mottled	**19 Mottled**
20 Mottled	**7 Mottled**
16 Mottled	**10 Mottled, 10 Dorsolateral Stripes**
13 Mottled	**5 Mottled, 9 Dorsolateral Stripes**
8 Mottled	**3 Mottled, 2 Dorsolateral Stripes**
15 Mottled	**3 Mottled, 10 Dorsolateral Stripes**
22 Mottled	**8 Dorsolateral Stripes**
6 Mottled	**10 Middorsal Stripe**
26 Mottled	**4 Mottled, 5 Middorsal Stripe, 1 Dorsolateral Stripes plus Middorsal Stripe**

In the following analysis the patterns will be considered separately.

DORSOLATERAL STRIPES

Considering Dorsolateral Stripes alone, the sample of adults taken at the same time and place as the eggs comprised **36** with Dorsolateral Stripes

and 95 without the stripes. Applying the same formula as that used in analyzing the *nubicola* data, the following table can now be compiled:

TABLE V

	Theoretical Clutches Dorsolateral Stripes dominant	Theoretical Clutches Dorsolateral Stripes recessive	Actual Clutches
Without Dorsolateral Stripes only	10.51	8.03	14
Mixed	8.58	10.38	5
Dorsolateral Stripes only	0.89	1.512	1
	x2=2.430	x2 = 7.358	
	P = 12.6%	P = 0.6%	

In this case it can be seen that the evidence is rather conclusive that the Dorsolateral Stripes gene is dominant, as is the case in *E. r. planirostris.*

MIDDORSAL STRIPE

Considering Middorsal Stripe alone, the sample of adults comprised 10 with Middorsal Stripe and **121** without it. The following table can thus be constructed:

TABLE VI

	Theoretical Clutches Middorsal Stripe dominant	Theoretical Clutches Middorsal Stripe recessive	Actual Clutches
Without Middorsal Stripe only	17.07	15.47	18
Mixed	2.88	4.42	1
Middorsal Stripe only	.06	.12	**1**
	x^2 = .3511	x2 = 1.832	
	P = 56.8%	P = 18.24%	

Here the data would permit considering the Middorsal Stripe gene to be either dominant or recessive.

Eleutherodactylus pantoni Dunn

In this species the female acts as a guardian as in ***nubicola*** and ***alticola.*** The number of eggs in each clutch, however, is much higher, averaging **91.4**

for the five clutches of eggs so far known (see Lynn and Dent, 1944, p. 238).

In *pantoni* the same three pattern modifications are present as are found in *nubicola,* namely, Dorsolateral Stripes, Middorsal Stripe and Picket. Thus, the same eight phenotypes would be possible. I have seen the following five: Mottled, Dorsolateral Stripes, Middorsal Stripe, Picket, and Picket plus Middorsal Stripe.

The following three clutches of *pantoni* eggs were taken in 1948:

Mother - Mottled
98 Mottled
Mother - Dorsolateral Stripes
14 Dorsolateral Stripes, 17 Mottled
Mother - Unknown
91 Mottled

In the case of the clutch containing only 31 offspring, the eggs were just beginning to hatch as they were found and many of the young hatchlings escaped. The 31 which were collected hatched as the eggs were being picked up.

Although the data are limited to three clutches, it is apparent that they are consistent with the data from the other species.

Eleutherodactylus nasutus Lutz

In addition to the data for the three species reported here and those for *planirostris* which have been published previously, Lutz *(in* Lynn and Lutz, 1947) has presented data from two clutches of eggs of *E. nasutus* in relation to the condition of Dorsolateral Stripes. In one clutch 7 of 9 of the offspring had Dorsolateral Stripes while in the other 6 of 12 that hatched from a clutch of 14 had Dorsolateral Stripes. She also mentions that some hatchlings from another clutch had a light middorsal line. Although she did not have enough information to justify any conclusions in regard to the Middorsal Stripe, her data for Dorsolateral Stripes seem to agree with the evidence from *planirostris* that the Dorsolateral Stripe condition is dominant to the non-striped.

DISCUSSION

While several interpretations of the data listed above are possible, the interpretation that seems to me to be most consistent with the observed facts, and the one which involves the fewest assumptions, is that Dorsolateral Stripes, Picket, and Middorsal Stripe are simple Mendelian traits with the gene for each situated in a separate locus. Certainly the three of them are not allelomorpic and the genes for Dorsolateral Stripes and Picket pattern seem to be unquestionably dominant.

The data presented are, to be sure, not conclusive evidence that the color pattern genes are homologous in the different species of *Eleutherodactylus.* In the frogs of the genus *Rana,* however, Moore (1943) demonstrated that the mutant gene for uniform is dominant to the gene for spotting in three distinct species, pipiens, *palustris,* and *areolata.* Furthermore, Sturtevant (1948, p. 230), after examination of the available data in different groups in both the plant and animal kingdoms, in addition to those for the genus *Drosophila,* thinks that "there can be no doubt that, in general, related species have essentially the same complements of genes." Therefore, since the assumption that the action of these genes is the same in the different species of *Eleutherodactylus* is consistent with the data and as there is no evidence against it, I believe that they should be so considered unless data are obtained to the contrary.

I have restricted my remarks on color patterns to the five species in which at least some genetic data are available, but the exhibition of two or more phenotypes is by no means restricted to these species. Many species, both in the West Indies and on the mainland, are known to have Dorsolateral Stripes and/or Middorsal Stripe. While there are, of course, species that do not have the pattern of Dorsolateral Stripes, there are other species in which it is present in every individual. The Picket pattern does not seem to be nearly so wide-spread as the patterns of Dorsolateral Stripe and Middorsal Stripe. I have no data on its occurrence outside of *pantoni* and *nubicola.*

In none of the Jamaican forms on which I have worked does there appear to be any correlation of pattern with morphology (e.g., wartiness) but in *E. polyptychus* in Central America there seems to be a relation between the arrangement of the warts on the back and . the pattern. In this form the warts on the back of an individual with Dorsolateral Stripes are in rows running cephalocaudad while in the mottled individuals they are more or less coincidental with the w-shaped suprascapular mark. A similar relationship between warts and pattern obtains in certain Mexican forms (see Taylor and Smith, 1945, p. 572). In no case, however, is it known at present just what the genetic relationship is between the arrangement of warts and the color pattern.

Finally, I would like to point out that there are other patterns in this genus which are probably genetic but for which no breeding data are available. Thus, in *E. orcutti* from the Blue Mountains of Jamaica, only Dorsolateral Stripes of the three basic modifications described above occurs, but in addition 4 out of 115 specimens collected in the summer of 1948 had the entire dorsal surface of the head colored a brilliant gold.

TABLE VII

Phenotype		Mottled	Dorsolateral Stripes	Picket	Middorsal Stripe	Dorsolateral Stripes and Middorsal Stripe	Dorsolateral Stripes and Picket	Middorsal Stripe and Picket	Dorsolateral Stripes and Middorsal Stripe and Picket	Number of individuals observed	
Genes		spm	Spm	sPm	spM	SpM	SPm	sPM	SPM	Adults	Hatchlings
Species	*planirostris*	×	×	—	—	—	—	—	—	2000 ±	1602
	nubicola	×	×	×	×	×	×	×	×	300	1002
	alticola	×	×	—	×	×	—	—	—	131	286
	pantoni	×	×	×	×	(×)	(×)	×	(×)	93	220
	nasutus	×	×	—	×	×	—	—	—	6	21

Table VII summarizes the known genes and accompanying phenotypes of five species of *Eleutherodactylus*. The occurrence of the phenotype in the species is indicated by an *X* sign. Those that theoretically should occur but that have not yet been observed are indicated by parentheses. The column of individuals observed refers only to material taken in the field or young hatched out in the laboratory in connection with this problem, since no attempt has been made to examine all specimens now in collections. In the case of *nasutus*, the data for which are taken from the literature, a few of the specimens in the United States National Museum were examined so that I could be sure that Miss Lutz and I were discussing the same patterns.

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PLATE I

Color patterns in *Eleutherodactylus nubicola.*

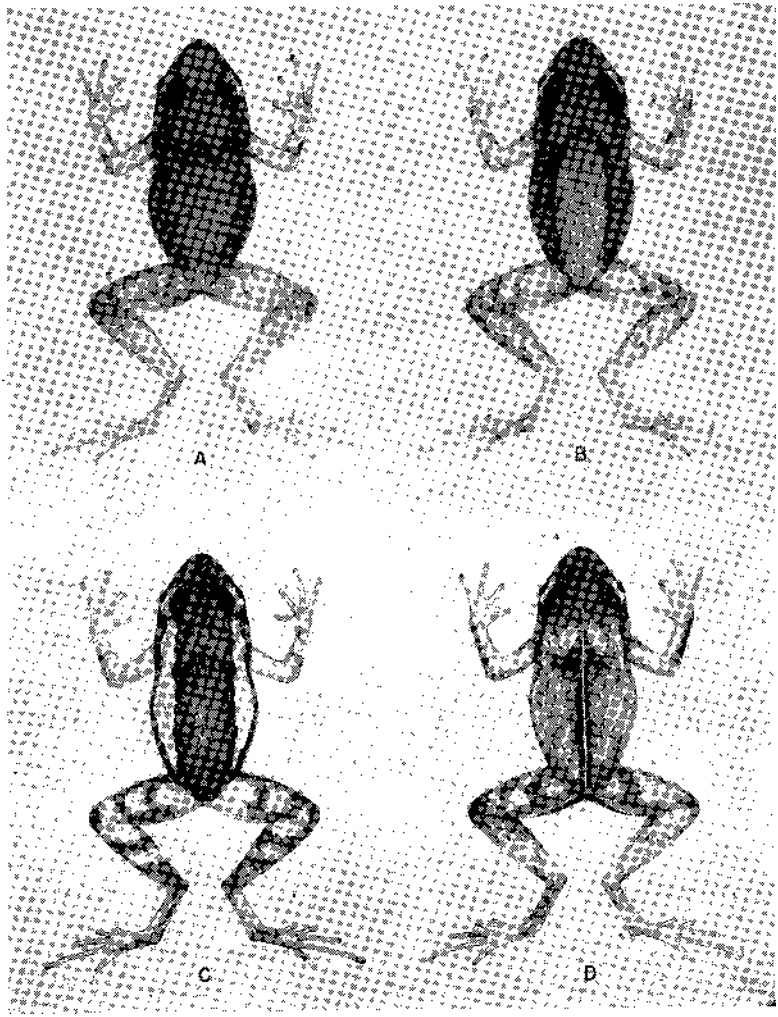
A--Mottled

B—Picket

C—Dorsolateral Stripes

D—Middorsal Stripe

Esther Coogle, delineator.


A
B
C
D